Tracing of a magnetic anomaly body

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If we attach an attitude acquiring equipment to the common frame on which the magnetic sensor and the attitude acquiring equipment are installed, aligned to coincide with each other, then we can rotate the acquired three component magnetic field data around each of the three axes of the common frame's coordinate system with the amount of the acquired three attitudes, i. e. yaw, pitch, roll. The components data as the result of rotation are now the same as we can get when we have measured the invariant magnetic field data with the frame reoriented to coincide with the geographical coordinate system. We used quaternion multiplication or quaternion rotation to get the relation between two coordinate systems. Once we calculated that relation between each sensor's coordinate system and the geographical coordinate system we applied quaternion rotation to the time series data from each sensor (xn(t), yn(t), zn(t)) and we got the time series data for each sensor (nn(t), en(t), dn(t)) as if we measured on new coordinate system reoriented to the geographical coordinate system. We are now doing inversion processing with CGLS (conjugate gradient least squares) algorithm by using three component magnetic field data acquired on a sensor array composed of three fluxgate magnetometers and reoriented to geographical coordinate system. The expected result of inversion will give us the possibility to trace the position of a magnetic anomaly body along time with superiority of performance of three components magnetic field data to scalar magnetic field data.

The possibility to trace the position of a magnetic anomaly body along time is very useful. But till now the tracing have been done mainly by using only the scalar magnetic data because of the difficulty to acquire the attitude data of the sensor body frame's coordinate system. If we attach an attitude acquiring equipment to the common frame on which the three component magnetic sensor and that attitude acquiring equipment are installed, aligned to coincide with each other, then we can rotate the acquired three component magnetic field data around each of the three axes of the common frame's coordinate system with the amount of the acquired three attitudes, i. e. yaw, pitch, roll. The components data as the result of rotation will be the same as we can get when we have measured the invariant magnetic field data with the frame reoriented to coincide with the geographical coordinate system. We applied quaternion multiplication or quaternion rotation to get the relation between two coordinate systems.

We deployed a sensor array composed of three fluxgate magnetometers, irregularly positioned intentionally and got time series of magnetic field data for each sensor (xn(t), yn(t), zn(t)). Once we calculated that relation between each sensor's coordinate system and the geographical coordinate system by using quaternion rotation, we calculated the time series data for each sensor (nn(t), en(t), dn(t)). To get the necessary data for quaternion rotation we did a set of absolute magnetic measurement near the sensor array with the help of the continuous three components data of CYG (Cheongyang) Magnetic Observatory, one of IMO (InterMagnet Magnetic Observatory) Network.

We are doing inversion processing with CGLS (conjugate gradient least squares) algorithm by using three component magnetic field data acquired on a sensor array composed of three fluxgate magnetometers and reoriented to geographical coordinate system. The expected result of inversion will give us the possibility to trace the position of a magnetic anomaly body along time with superiority of performance of three components magnetic field data to scalar magnetic field data.

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